Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Use of Spectrum Bands Above 24 GHz For Mobile Radio Services	)	GN Docket No. 14-177
	)	
Establishing a More Flexible Framework to Facilitate Satellite Operations in the 27.5-28.35 GHz and 37.5-40 GHz Bands	)	IB Docket No. 15-256
	)	
Petition for Rulemaking of the Fixed Wireless Communications Coalition to Create Service Rules for the 42-43.5 GHz Band	)	RM-11664
	)	
Amendment of Parts 1, 22, 24, 27, 74, 80, 90, 95, and 101 To Establish Uniform License Renewal, Discontinuance of Operation, and Geographic Partitioning and Spectrum Disaggregation Rules and Policies for Certain Wireless Radio Services	)	WT Docket No. 10-112
	)	
Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands; Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5-42.5 GHz Frequency Band; Allocation of Spectrum in the 46.9-47.0 GHz Frequency Band for Wireless Services; and Allocation of Spectrum in the 37.0-38.0 GHz and 40.0-40.5 GHz for Government Operations	)	IB Docket No. 97-95

REPLY COMMENT OF INTEL CORPORATION

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October 31, 2016

TABLE OF CONTENTS

I. Introduction and summary

Intel Corporation ("Intel") respectfully submits this Reply Comment to the *Further Notice* in the Commission's proceeding on the use of spectrum bands above 24 GHz for mobile radio services. Intel is a leader in designing and building the essential technologies that serve as the foundation for the world's computing and communications devices.

Intel strongly supports the Commission's efforts to make millimeter wave (mmW) spectrum available for terrestrial mobile (5G) use expeditiously and flexibly and we applaud their actions to date. However, Intel cautions that the U.S. millimeter wave (mmW) 5G market advantage gained from the Commission's expeditious actions to-date could be eroded if the rules contain mandates to implement complex and unproven frameworks such as the Spectrum Access System (SAS) and use-it-or-share-it. Neither of these mandates is essential to mmW 5G and they could be safely revisited in the future when mmW 5G technology deployments are stable and market adoption is firmly established. As we noted in our reply comments to the mmW NPRM, "the additional uncertainty brought by those proposals would unnecessarily hamper the post-rulemaking development phase and could ultimately impede sustained U.S. investment in mmW 5G."[1]

The foundation that the Commission has put in place for mmW 5G leadership utilizes the proven-successful exclusive licensed and unlicensed models. In addition, the Commission has put in place a middle-ground license-by-rule, site-license sharing framework to satisfy potential users for whom neither the unlicensed nor the exclusive licensed assignment model meets their needs. While the demand from this potential user group is not known, this middle-ground case in the 37-37.6 GHz band can develop based on its own merits without impeding deployments in other bands. In sum, the Commission has put in place spectrum assignment mechanisms that will collectively satisfy all user classes. Within that foundation, the Commission has put in place

[1] mmW NPRM reply comments of Intel at 2 (posted Feb. 29, 2016 to ECFS).

a structure for sharing between mmW Federal and non-Federal incumbents, new terrestrial mobile operations, new Federal users, and existing and future commercial satellite users in the mmW bands. This already demonstrates significant progress on spectrum sharing, negating the need for the additional dynamic or opportunistic sharing proposals.

Over fifty parties submitted comments to the *Further Notice*, and a robust record has developed. Key issues such as the consideration of permitting fixed and mobile use in additional mmW bands (the 24, 32, 42, 47/50, 70/80 bands as well as the new 37-37.6 GHz band created via the Report and Order) and performance requirements all received significant attention from commenters. Intel has reviewed the comment record on mmW expansion bands and recommends a prioritized approach based on maximizing radio tuning ranges adjacent to the bands recently authorized by the Commission. Intel does not support a use-or-share mandate or a SAS sharing requirement in any mmW bands at this time. Regarding performance requirements and in consideration of the nascent mmW 5G market, Intel believes that as the market develops and case studies become available, a sensible set of flexible, data-driven performance requirements will emerge. Regarding the request by the satellite industry to impose pre-emptive requirements on terrestrial mobile systems, Intel finds the request lacks justification and consistency. Finally, we reiterate our support for expeditiously permitting 60 GHz unlicensed operations aboard aircraft and believe that an approach which allows immediate access to some channels and further studies for other channels would be appropriate.

II. Additional mmW bands can be prioritized based upon tuning-range commonality.

Historically, Intel has supported bringing more spectrum to the marketplace under flexible rules, which allows innovations to flourish. We continue to support that approach. As the Commission moves forward with considering the new mmW bands proposed in the *Further Notice*, we concur with the general approach taken by

other commenters where new bands that are plausibly within the tuning range of the first swath of licensed mmW bands (the 28 and 37-40 GHz bands) should be prioritized.

A. Harmonization of radio tuning ranges is a key consideration.

Harmonization has long been an important consideration for mobile broadband. In particular, harmonization facilitates economies of scale and global roaming. However, harmonization is not limited to global agreement to use the exact same frequencies or band plans. We concur with Ericsson's observation that, "The benefits of global harmonization are not limited to situations where all regions have identical spectrum allocations, however. These benefits can also be derived from "tuning range" solutions, in which adjacent or nearly-adjacent bands can be considered harmonized so long as equipment can be reconfigured to operate over multiple bands, *i.e.*, they are within the same "tuning range."[2]

"Tuning ranges" are critical to delivering the benefits of harmonization. The radio units in user devices which are under development for one band can also be utilized in some nearby bands without requiring entirely new development efforts. When considering the feasibility of covering harmonized frequency ranges with a single radio unit, there are cost, size, performance, and complexity trade-offs. As technology and volume manufacturing capabilities advance over time, further widening of radio tuning ranges may become feasible.

The concept of radio tuning ranges is also an important consideration with respect to World Radiocommunication Conference 2019 (WRC-19) agenda item 1.13 on International Mobile Telecommunications (IMT). Given differences in uses and priorities among various countries and regions, it will be difficult to reach consensus on the global identification to IMT for individual bands. However, radio tuning ranges can be created that potentially cover more than one region. For example, the United States has already decided to move

[2] FNPRM comments of Ericsson at 4. See also FNPRM comments of Nokia at 7.

forward with enabling mobile broadband in 27.5-28.35 GHz, and other countries plan to use 27.5-29.5 GHz while Europe is considering 24.5-27.5 GHz as a priority band for 5G[3]: the combination of the 28 GHz band in some countries and 26 GHz band in other countries could create an opportunity for a band plan where all or significant part of the 24.25-29.5 GHz range has meaningful chances for being supported by a single radio, thus driving the economies of scale and facilitating global roaming.

B. A Spectrum Access System (SAS) is not appropriate in the mmW bands.

Regarding the proposals by the Commission and/or by certain commenters for the use of a Spectrum Access System (SAS), Intel opposes the propagation of this complex and unproven model into any mmW bands at this time. As we explained in our comments, "The SAS was custom-designed for the idiosyncrasies of the 3.5 GHz band, and its viability and scalability is not simply dependent on the still-evolving technical implementation or the theoretical capabilities. The implementation of the SAS in 3.5 GHz is also reliant on the success and sustainability of the SAS administrator business model, which is unproven, and on certain novel policy choices made by the Commission which underpin operation of sharing in the band. The uncertainty in the working combination of untried technical, business model, and policy aspects of the SAS framework is quite large, and that should guide against any consideration to propagate this complex framework to other bands until it is resting on a far more substantive footing of sustained operational proof."[4]

[3] http://rspg-spectrum.eu/wp-content/uploads/2016/09/2016-10-03_RSPG_2nd_stakeholder_workshop.pdf (Slide 13)
[4] FNPRM comments of Intel at 5.

C. Comments on specific mmW bands proposed in the Further Notice.

1. The 24GHz band (24.25-24.45/24.75-25.25 GHz):

Intel believes the 24 GHz bands should be prioritized due to the potential opportunity to support all or a significant part of the 24.25-29.5 GHz frequency range with a single radio in the future. As stated above, tuning ranges should be an important consideration as they can facilitate benefits of harmonization such as economies of scale and roaming. Furthermore, Europe is also considering the 24.5-27.5 GHz frequency range as part of its "strategic roadmap for 5G" systems. The combination of the potential radio tuning range and the anticipated European support for this frequency range would likely allow expeditious product support and economies of scale for bands immediately below 27.5 GHz. Although the 24 GHz bands proposed in the *Further Notice* do not offer very large bandwidth compared to other mmW bands, they are within the potential tuning range of 28 GHz products and should be prioritized. It should also be noted that if there are opportunities to explore the possibility of any spectrum allocations within the 25.25-27.5 GHz range in the future, the additional bandwidth could be put to valuable use with minimal product development effort.

2. The 32 GHz band (31.8-33.4 GHz):

Although the 32 GHz band is also near the 28 GHz band, the 32 GHz band cannot necessarily be supported by the same radio tuning range due to existence of passive services between 31 and 32 GHz. According to ITU-R Radio Regulations, no emissions are allowed within 31.3-31.8 GHz frequency range. This very stringent requirement has two impacts on creating an extended tuning range together with the 28 GHz band. First, the need for possible guard bands to prevent emissions into the 31.3-31.8 GHz bands: these guard bands would need to be carved out above 31.8 GHz, thereby reducing the amount of useable spectrum in the 32 GHz band. Second, integrating the 32 GHz and 28 GHz bands into a single radio tuning range would require implementation of complex and costly band-stop (notch) filters with tens of dBs of isolation (e.g. over 70 dB) in

order to fully suppress any emissions in the 31.3-31.8 GHz down to the thermal noise level. While this degree of isolation might be attainable with a more costly solution involving discrete components such as waveguide filters, it would not be readily attainable using the integrated components which are needed to enable low cost consumer devices for the 28 GHz band. As a result, we believe this band poses more development challenges than the 24 and the 42 GHz bands.

3. The 42 GHz band (42-42.5 GHz):

Intel believes the 42 GHz band also offers the potential opportunity to be supported by a single radio as it is within the likely tuning range of adjacent bands (37-40 GHz) and the products which are currently being developed for the U.S. market. As stated above, tuning ranges should be an important consideration as they can facilitate benefits of harmonization such as economies of scale and roaming. It should also be noted that CEPT (Europe) proposed the 40.5-43.5 GHz frequency range for consideration under WRC-19 agenda item 1.13. The combination of the potential radio tuning range (in combination with 37-40 GHz products) and European support for the 40.5-43.5 GHz frequency range would likely allow expeditious product support and economies of scale for the 42 GHz band.

4. The 47/50 GHz bands (47.2-50.2 GHz and 50.4-52.6 GHz):

The spectrum bands around 47/50 GHz are not within the practical radio tuning range of the bands already opened for 5G deployments in the U.S. (28 and 37-40 GHz). Therefore, enabling support for these new bands (as well as 32 GHz) would likely require entirely new product development efforts to support these bands. It should be noted that these new product development efforts could also be required from additional parts of the component development ecosystem such as RF component and filter manufacturers.

5. The 70/80 GHz bands (71-76 GHz and 81-86 GHz):

The 70/80 GHz bands currently have thousands of deployed point-to-point links and will likely be important bands for mmW backhaul. Since a well-functioning registration framework already exists, these bands can be put to immediate backhaul use. Regarding mobile use in this band, we understand that some manufacturers are currently studying the possibility of enabling mobile access, to see if coexistence of mobile and fixed services can be accomplished. Regarding SAS, Intel concurs with the substantial majority of commenters that the proposed SAS framework is not appropriate for the 70/80 GHz bands.[5]

III. Performance requirements should be data-driven and therefore should evolve over time as the mmW 5G market develops and case studies become available.

Several common themes were apparent in the comment record regarding performance requirements. Commenters noted the need for flexibility in the requirements and that there are currently many unknown dimensions to mmW 5G technologies and services, so the Commission should not rush to create metrics—especially for a category like the Internet of Things (IoT) which encompasses a wide range of applications and services and does not have a consistent definition. For example, Ericsson notes "there is plenty of time to assess what the appropriate requirements and metrics should be as use of the Spectrum Frontiers develops,"[6] and the Competitive Carriers Association explains "new performance metrics…must be postponed until both stakeholders and the Commission better understand how IoT-type services may be implemented."[7]

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[5] FNPRM comments of: Telecommunications Industry Association at 14; Anova at 6; Micronet at 4; Dynamic Spectrum Alliance at 7; Microsoft at 8; NCTA at 8; 5G Americas at 7; Ericsson at 14; CTIA at 14; Google at 3; Siklu at 3; NSMA at 4; Fastback Networks at 3; Mobile Future at 4; E-Band at 2; Competitive Carriers Association at 5; Qualcomm at 12; Open Technology Institute / Public Knowledge at 20; Collinear Networks at 8; Huawei at 10; Wi-Fi Alliance at 6; T-Mobile at 19; Comsearch at 4.

[6] FNPRM comments of Ericsson at 18.

[7] FNPRM comments of Competitive Carriers Association at 7.

It is also useful to note the perspectives expressed by various licensees and network operators who would be charged with investing in and building out these new mmW 5G networks (and ultimately, complying with these requirements). Verizon notes that "it is still too early in the product cycles of 5G technologies to identify metrics tailored to 5G deployments" and that the Commission should "[return] to this question as 5G technologies and Internet of Things services continue to evolve.[8] Straight Path notes that "the use cases for 5G have not been, and may not be, fully developed for years."[9] AT&T notes that "5G use cases and services are still being developed" and since "5G service remains undefined and standards have not been completed, the Commission should not, at this time, adopt technical rules or performance requirements that may be preclusive of use cases that are not yet understood."[10] T-Mobile notes "it is premature for the Commission to attempt to adopt additional rules or benchmarks seeking to cover every possible application" and that "It may be appropriate, as technologies develop and performance deadlines draw nearer, for the Commission to create additional safe harbors based on developing use cases, but taking that step now is unnecessary."[11] Nextlink notes "the Commission can, and likely will, adjust its performance requirements to reflect the developing marketplace and to promote 5G services."[12] Southern Company Services notes "as M2M services and the IoT are just emerging, it may be impractical, and unwise, to define specific numbers for the levels of devices, sessions, and data volume that would be appropriate milestones."[13]

We agree with these sentiments, and we continue to believe—as we explained in our NPRM comments—that "the prudent course of current action would be to define a framework for the requirements and set guide posts and expectations for future actions, and then revisit it in the future when better information

[8] FNPRM comments of Verizon at 8.
[9] FNPRM comments of Straight Path at 11.
[10] FNPRM comments of AT&T at 7.
[11] FNPRM comments of T-Mobile at 26.
[12] FNPRM comments of Nextlink at 20.
[13] FNPRM comments of Southern Company Services at 6.

is available. It is neither necessary nor possible to perfectly define these requirements out of the gate."[14] Intel believes, and the comment record demonstrates, this topic is deserving of dedicated longer-term treatment and we recommend that the Commission open a stand-alone proceeding so that it can collect focused information on proposals, experiences, and case studies, which will lead to the desired data-driven performance requirements.

Several commenters also note there is value in case-by-case evaluation of performance requirements, as proposed by the Commission.[15] For example, Qualcomm explains, "the FCC should evaluate performance showings on a case-by-case basis at this early stage to afford licensees the necessary flexibility."[16] Intel believes case-by-case evaluation would be an appropriate means to gather a substantive record of service types, temporal, spatial, and bandwidth profiles etc., in order to ultimately reach data-driven requirements. While case-by-case evaluation could initially be administratively burdensome for both the Commission and the licensee, that burden should be weighed against the alternative of setting inappropriate requirements that are not data-driven but that are less administratively burdensome. As more case studies are recorded, this burden should be lessened, and both the Commission and licensees can draw upon the record for substantial similarity purposes, which should greatly streamline the process going forward. We believe it would be worthwhile to explore an incentive for licensees to submit highly detailed case studies and utilization data into the record.

Finally, we note that a minority of commenters propose a use-it-or-share-it obligation in lieu of performance requirements.[17] Intel opposes such an obligation in the mmW bands during the 10 year license term, and we explain the multiple reasons for our position in both our NPRM and *Further Notice* comments[18]

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[14] mmW NPRM comments of Intel at 25 (posted Jan 27, 2016 to ECFS).
[15] FNPRM ¶470.
[16] FNPRM comments of Qualcomm at 13.
[17] FNPRM comments of: Microsoft at 13, NCTA at 17, Facebook at 7, Federated Wireless at 11.
[18] FNPRM comments of Intel at 16-21. See also NPRM comments of Intel at 20-23.

However, as we noted in our comments to the *Further Notice*, "the secondary market rules adopted in the Report and Order for the licensed mmW bands would permit licensees to *voluntarily* share unused spectrum partitions and/or disaggregations" and a "voluntary sharing approach would be incentive-based, which should always be the first preference compared to mandates."[19] We discuss this further in the next section on use-it-or-share-it.

IV. A streamlined, voluntary framework for licensees to share spectrum should be preferred over a use-or-share mandate.

The comment record in the *Further Notice* reiterates the substantial and detailed opposition to imposing a use-or-share mandate in the mmW bands,[20] and that opposition is independent of the specific implementation model. Additional issues surface when specific implementation models are considered, but we remain convinced that the higher-level issues with the proposition are applicable across all implementations, and use-or-share should not be adopted.

Regulatory mandates such as use-or-share should only be considered when there is evidence of a failure to satisfy a well-documented need. As nascent spectrum, there is no such evidence of failure—or even any trend—in the mmW bands. In our comments, we suggested a voluntary incentive-based approach for licensees to share unused spectrum, rooted in the secondary market rules and including an investigation of ways to streamline secondary market transactions (partitioning and disaggregation). However, it is important to recognize that the unused spectrum is not likely to be in desirable locations, and can be recalled by the licensee at any time during the term of the license. We elaborated on the implications of these mitigating factors in our

[19] FNPRM comments of Intel at 20.

[20] *See* FNPRM comments of: 5G Americas at 14-23; Telecommunications Industry Association at 19-20; Straight Path at 7-10; Intel at 16-21; Ericsson at 19-20; CTIA at 19-22; Mobile Future at 5-6; Competitive Carriers Association at 4-7; Qualcomm at 15; Nextlink Wireless at 21-28; Verizon at 2, 3-4; T-Mobile at 24-25, 26.

comments.[21] Thus, even under a market-oriented approach of a voluntary sharing framework with low barriers to entry and low administrative costs, the demand for this unused spectrum is only likely to materialize when alternative bands with no such encumbrances are approaching capacity and users must seek alternative spectrum. This is all the more reason to seek the most straightforward voluntary approach possible since the operational consequences of a lack of demonstrated or vigorous demand for this unused spectrum would be minimized.

In summary, Intel believes that a use-or-share mandate should not be pursued for the licensed mmW bands, and certainly not prior to the expiration of the 10-year license term. Instead, a streamlined, voluntary, incentive based approach could be pursued, but even under a best-case outcome of mutually beneficial operation of the sharing framework between licensees and sharing parties, it is not likely to meet the optimistic shared utilization expectations held by some use-or-share advocates.

A. Arguments advanced by use-or-share advocates are not persuasive.

Intel's comments to the *Further Notice* offered significant reasons why we believe a use-or-share mandate should not be pursued.[22] One argument advanced by advocates involves a use-or-share mandate being positioned essentially as a means to require SAS implementations more broadly, and *vice versa*.[23] SAS should not be used as a justification for use-or-share, and use-or-share should not be used as a justification for SAS.

[21] FNPRM comments of Intel at 16-18.
[22] FNPRM comments of Intel at 16-21.
[23] *See e.g.* FNPRM comments of Federated Wireless at 10.

Use-or-share advocates also put forth claims about increased spectrum efficiency or intensity of use,[24] or claims related to preventing spectrum warehousing,[25] or positioning use-or-share as an alternative to performance requirements.[26] We do not find these arguments persuasive, and they are addressed below.

An increase in spectrum efficiency/intensity of use does not occur simply because additional spectrum is available. There are well-established differences in demand for spectrum in different locations. For an efficiency measure to increase, the additional spectrum must be available in a desired location where it will actually be used, and must not simply be used as a substitute for other suitable spectrum. Intel explained the issues with the "increased spectrum efficiency" argument in our comments to the *Further Notice.*[27]

Regarding the claims of use-or-share as a solution to spectrum warehousing, the statutory obligations from acquiring an exclusive license define that licensees are already required to meet time-bound performance (build-out) requirements which (among other things) prevent warehousing of spectrum.[28] Such requirements can vary by spectrum band, and indeed the Report and Order has set a baseline for those requirements[29] while the *Further Notice* seeks to develop additional requirements that will better reflect the nascent state of 5G market developments.[30] For the mmW bands these performance obligations (per the Report and Order) engage at the end of the 10-year license term and include renewal expectancy.[31] Furthermore, in the Report and Order, the Commission has definitively settled the matter of performance requirements meeting the anti-warehousing

[24] *See e.g.* FNPRM comments of: Starry at 5, NCTA at 18, Federated Wireless at 11.
[25] *See e.g.* FNPRM comments of: Dynamic Spectrum Alliance at 7, Microsoft at 14.
[26] *See e.g.* FNPRM comments of: Microsoft at 13, NCTA at 17, Facebook at 7.
[27] FNPRM comments of Intel at 17-18.
[28] 47 U.S.C. 309(j)(4)(B), "include performance requirements, such as appropriate deadlines and penalties for performance failures, to ensure prompt delivery of service to rural areas, *to prevent stockpiling or warehousing of spectrum* by licensees or permittees, and to promote investment in and rapid deployment of new technologies and services.(*emphasis added*)
[29] mmW R&O ¶¶203-220.
[30] mmW FNPRM ¶¶465-470.
[31] mmW R&O ¶¶176-177.

requirement, noting that "the foregoing performance requirements are feasible in these bands, and the best method to prevent warehousing in this context."[32]

Regarding a use-or-share obligation as an alternative to performance requirements, this is indirectly related to the anti-warehousing discussion above. Prospective licensees are on record opposing mandated use-or-share requirements. Licensees will have every motivation to work with the Commission in finalizing specific mmW performance requirements to better account for 5G services (noting that the default population-based metrics that were put in place via the Report and Order might not be appropriate for certain types of 5G services).

Although there is some support in the record for a use-or-share obligation, no persuasive case has been made by advocates in support of a use-or-share mandate, while multiple reasons have been proffered that demonstrate a use-or-share mandate would not be sound policy.

V. Requests by the satellite industry to impose pre-emptive requirements on terrestrial mobile systems in the 24, 47, and 50 GHz bands lack justification and are inconsistent with the Commission's conclusions in other mmW bands.

The Satellite Industry Association (SIA) requests that the Commission "adopt network configuration and operational requirements for UMFUS systems in the 24, 47, and 50 GHz bands to ensure the avoidance of aggregate interference into international satellite systems. Such measures would be much easier to adopt and implement now, while UMFUS is still in a conceptual stage, rather than later, when UMFUS systems may already be in operation and any interference would be difficult or impossible to effectively address."[33]

[32] mmW R&O ¶223.
[33] FNPRM comments of Satellite Industry Association at 16.

This request from SIA is in conflict with the Commission's conclusion in the Report and Order with respect to the 28 GHz band that "the potential for aggregate interference rising to the level of harmful interference is unlikely," and the associated decision to "decline to establish any regulatory limit on aggregate power levels."[34] More explicitly, the Commission states, "specific technical limits on UMFUS stations are not necessary at this time to address aggregate interference."[35] Intel supports these conclusions by the Commission.

There is no record evidence that the potential for aggregate interference in these other uplink (Earth-to-space) bands merits special treatment relative to the decision reached for the 28 GHz band. Indeed, the Commission stated that its "decision not to set specific limits on aggregate interference is consistent with our treatment of that issue in other bands."[36] As the pre-emptive measures proposed by SIA appear draconian given the potential impact on the deployment of mobile systems in the absence of any evidence of a problem, Intel opposes the measures proposed by SIA.

VI. The Commission should take steps to permit 60 GHz operation on-board aircraft.

There are many benefits from permitting use of IEEE 802.11ad (WiGig®) products operating in the 60 GHz band[37] on-board aircraft, for both consumers as well as potentially the airline industry. Previous concerns have revolved around ensuring the protection of incumbent systems from WiGig operation on channel 1 (57.24-59.40 GHz).[38]

WiGig technology permits operation of any combination of channels, *i.e.* individual channels can be selectively enabled or disabled. Intel supports expeditiously permitting operation on board aircraft on any

[34] mmW R&O ¶61.
[35] mmW R&O ¶294.
[36] mmW R&O ¶68
[37] *See* mmW NPRM comments of Intel at 17-19 (posted Jan 27, 2016 to ECFS).
[38] *See* WiGig industry group, written *ex parte*, filed by Intel (posted Apr 26, 2016 to ECFS).

channels which do not require further study to ensure sufficient protection of incumbent services. Intel also supports prioritizing further studies in order to allow timely resolution of any remaining issues in order to enable WiGig operation on board aircraft in the 57-71 GHz frequency range on the maximum number of channels.

VII. Conclusions

Intel recommends that the mmW expansion bands are best introduced under an approach that prioritizes bands that are within the tuning range of the first swath of mmW bands. This will maximize economies of scale, global roaming, and the timely availability of mmW equipment. Regarding performance requirements for licensees, they should be data-driven, based on mmW deployment case studies and other market development data. Since the mmW 5G market is just emerging, sufficient data does not yet exist at this time, and the Commission should not rush to finalize the requirements speculatively. Regarding mandates such as use-or-share and SAS, these would not be appropriate in the mmW bands at this time. Regarding the satellite industry request for pre-emptive requirements on terrestrial mobile equipment, this request lacks proper justifications, and is inconsistent with precedent. Regarding 60 GHz use aboard aircraft, an approach that permits the introduction of 60 GHz channels to provide services should be considered for some channels: this approach avoids delays in the market introduction of a capability that could be immediately used, while permitting further studies on other channels.